Plant Species Composition, Diversity and Cover within Reestablished Wet Prairie Communities

Expectation: Restoration of a wet prairie community on portions of the floodplain where wet prairie communities that existed prior to channelization have been drained and replaced by upland and mesophytic communities. In these areas, obligate and facultative wetland species (Reed 1988) will account for >75% of the species composition and > 90% of live plant cover; however, cover of two facultative wetland pasture grasses, *Axonopus fissifolius* and *Hemarthria altissima* that have been seeded for cattle forage, will decline to < 5% of the cover. The reestablished wet prairie community will have significantly higher plant species diversity than the two other dominant plant communities (i.e., broadleaf marsh, wetland shrub) that are expected on the restored Kissimmee River floodplain, unless dominated (combined cover > 50%) by *Panicum hemitomon*, *Rhynchospora inundata* and/or *Leersia hexandra*.

Author: Louis A. Toth, South Florida Water Management District

Date: July 2, 1999

Relevant Endpoints:
Sociopolitical - Nuisance (Exotic) Species
Restoration - Biological Integrity - Community Structure
Restoration - Biological Integrity - Colonization Rates
Restoration - Biological Integrity - Population Abundance
Restoration - Biological Integrity - Biodiversity
Restoration - System Functional Integrity - Habitat Quality
Restoration - System Functional Integrity - Habitat Diversity

Baseline Condition: As a result of channelization, over 2100 ha (48%) of the wet prairie that occurred on the historic floodplain (Pierce et al. 1982) was drained and converted to cattle pasture and/or has become dominated by upland and mesophytic vegetation communities (Milleson et al. 1980).

Baseline plant species composition and cover data were collected in July – October 1998 in 5 m x 20 m permanent plots on portions of the channelized floodplain in Pools A (n=6) and C (n=21) where wet prairie communities had existed prior to channelization but are now covered by an upland or mesophytic herbaceous (pasture) community. Obligate and facultative wetland species accounted for 55 - 67% (mean = 55.3 $\pm$ 3.0%) of the species composition in control plots in Pool A and 29 – 71% (mean = 50.1 $\pm$ 2.8%) of the taxa in plots in Pool C. Existing vegetation cover within these plots was dominated (> 75% cover) by three species that are commonly seeded for cattle forage: *Paspalum notatum* (19 plots), *Axonopus fissifolius* (5 plots), *P. notatum* & *A. fissifolius* (2 plots) and *Hemarthria altissima* (1 plot). *Paspalum notatum* is a facultative upland species while *A. fissifolius* and *Hemarthria* are facultative wetland taxa. Obligate and facultative wetland species generally accounted for < 30% of the live plant cover in all sample plots except plots where *A. fissifolius* or *Hemarthria* were dominant (i.e., plots 337,439 and 440 in Pool A and plots 3,30,35 and 140 in Pool C) (Table 1). Mean baseline plant species diversity in these existing herbaceous pasture/historic wet prairie plots was lower than plant species diversity in all other groups of plots on the channelized floodplain except baseline plots in existing herbaceous pasture/historic broadleaf marsh (Table 2).

Reference Condition: Based on photointerpretation of prechannelization aerial photography (Pierce et al. 1982), 4126 ha of the historic floodplain were covered by wet prairie communities. There are no historic data on plant species composition and cover characteristics of wet prairie communities on the Kissimmee River floodplain although *Panicum hemitomon* and *Rhynchospora inundata* were dominant indicator species in some historic wet prairie

communities (Pierce et al. 1982). Reference conditions were derived from species composition (Toth 1991) and standing crop biomass (Toth, unpublished) data from transects in reestablished wet prairie in the demonstration project area of Pool B (i.e., Duck Slough and Pine Island Slough) and in an impoundment (Rattlesnake Hammock) in Pool A (Toth et al. 1998)

Plant species composition data were collected between 1988-1994 in 1 m^2 quadrats at 7.6 m intervals along a 200 m transect in Pine Island Slough, 380 m transect in Duck Slough and 685 m transect in Rattlesnake Hammock. Obligate and facultative wetland species accounted for a mean of > 80% of the species composition in sample quadrats along each transect (Table 3). Based on characteristics of these and other remnant wet prairie communities (Toth et al., 1995), species composition within historic wet prairie likely consisted of a diverse complement of obligate and facultative wetland species including grasses, *Panicum hemitomon*, *Leersia hexandra, Luziola fluitans*, forbs, *Alternanthera philoxeroides, Bacopa caroliniana, Bacopa monnieri, Centella asiatica, Diodea virginiana, Hydrocotyle umbellata, Polygonum punctatum,* and multiple species of Cyperaceae (*Carex, Cyperus, Eleocharis, Fimbristylis, Juncus, Rhynchospora* and *Scleria*) (Table 4).

Reference conditions for relative cover of plant species in wet prairie were based on standing crop biomass data from ten (equally spaced) 0.5 m^2 quadrats along transects in Pine Island Slough and Duck Slough (1990) and Rattlesnake Hammock (1992). Obligate and facultative wetland species accounted for a mean of > 90% of the standing crop biomass along each transect. *Panicum hemitomon* (41.5%) and *Leersia hexandra* (28.6%) were dominant along the Rattlesnake Hammock transect while *Panicum hemitomon* (34.7%), *Rhynchospora inundata* (25.5%) and *Leersia hexandra* (11.3%) had the greatest standing crop in Pine Island. Duck Slough had higher plant species diversity, as no species accounted for > 25% of the total standing crop. Species accounting for > 5% of cumulative biomass in samples from Duck Slough included *Centella asiatica* (21.7%), *Diodea virgininia* (11.8%), *Panicum hemitomon* (11.1%), *Phyla nodiflora* (8.0%), *Rhynchospora inundata* (7.2%), *Polygonum punctatum* (6.1%) and *Juncus effusus* (5.4%). Mean plant species diversity (based on relative biomass of each plant species in the ten standing crop samples) in Pine Island Slough and Duck Slough (Table 3) were significantly greater ($p(t) < 0.05$) than plant species diversity along transects in two remnant broadleaf marshes (mean diversity = 0.57 and 0.42) in the lower end of Pool B; however, due to dominance of *Panicum hemitomon*, mean plant species diversity in Rattlesnake Hammock was significantly lower ($p(t) < 0.05$) than in one of these remnant broadleaf marshes and not significantly different than plant species diversity in the other.

Mechanism for Achieving Expectation:

Restoration of wet prairie communities will be accomplished through reestablishment of historical inundation characteristics (3-8 month hydroperiods with depths < 25 cm) on floodplain elevations (peripheral) where wet prairie existed historically. Shorter and more variable hydroperiods generally will lead to higher plant species diversity in reestablished wet prairie than in broadleaf marsh and wetland shrub, which will be subjected to more continuous inundation; however, indicator wet prairie species such as *Panicum hemitomon*, *Rhynchospora inundata* and *Leersia hexandra* will likely dominate wet prairie communities with deeper and longer hydroperiods (Toth et al. 1995). Wet prairie species will reestablish from remnant seed banks (Wetzel et al. 2001) and dispersal of nearby remnant propagules. Increased hydroperiods will eliminate upland and mesophytic species on the existing drained floodplain.

Adjustments for External Constraints: Drainage canals and levees allowed wet prairie to occupy relatively low elevations on some portions of the historic floodplain. Degradation of these levees and filling of these ditches will result in reestablishment of a broadleaf marsh rather than wet prairie community in these locations.

Means of Evaluation: Achievement of this expectation will be evaluated by post-restoration sampling of the established permanent plots in Pool C and simultaneous sampling of control plots in Pool A. Plant species composition, cover and diversity will be evaluated annually during August-September. As during baseline sampling, cover of each plant species will be estimated using modified Daubenmire cover classes (Table 5). The expectation will be evaluated by reestablishment of all wet prairie criteria (i.e., proportional cover (> 90%) and composition (> 75%) of obligate and facultative wetland species, proportional cover of *A. fissifolius* and *H. altissima* (< 5%), dominance (> 50% cover) by *Panicum hemitomon, Rhynchospora inundata* and/or *Leersia hexandra* or significantly greater diversity than restored broadleaf marsh and wetland shrub communities) in each plot in Pool C. Mean plant species diversity within reestablished wet prairie plots will be compared to mean plant species diversity within plots in reestablished broadleaf marsh and wetland shrub communities.

Time Course: Based on observed responses to floodplain inundation experiments such as the demonstration project (Toth 1991) and Rattlesnake Hammock impoundment (Toth et al. 1998), wet prairie species are expected to begin to colonize during the first year after hydrologic regimes are reestablished. All aspects of this expectation will be achieved within 3-5 years after reestablishment of prechannelization hydroperiods. The time period for this expected response will be delayed if dryer than normal climatic conditions lead to shorter hydroperiods.

Table 1. Baseline plant species composition, cover and species diversity in upland herbaceous (pasture) plots (5 m x 20 m) in Pools A and C. Species diversity was based on relative cover of plant species in each plot.

	% Cover of *Axonopus or Hemarthia*	% Cover of Obligate and Facultative Wetland Species	% of Obligate and Facultative Wetland Species	Plant Species Diversity
Pool A				
412	< 5	15.5	58.3	0.49
413	6 – 25	26.2	66.7	0.56
417	6 – 25	27.1	55.0	0.94
337	51 – 75	73.0	56.7	1.11
440	51 – 75	60.1	46.4	1.03
439	51 – 75	58.6	48.7	1.23
Pool C				
1	< 5	26.4	47.8	0.85
2	< 5	19.5	69.2	0.53
202	< 5	26.7	46.2	0.92
3	51-75*	71.2	46.2	0.68
123	< 5	15.6	44.4	0.69
125	< 5	14.4	47.1	0.71
5	< 5	22.6	56.5	0.98
6	< 5	22.4	68.8	0.63
122	0	17.6	45.8	0.88
101	< 5	16.0	41.7	0.81
102	6 – 25	21.6	38.9	0.73
103	< 5	10.0	29.4	0.66
30	76 – 95	73.8	63.2	0.80
35	51 – 75	62.4	61.5	0.98
37	26 – 50	37.7	30.0	0.96
34	6 – 25	22.2	50.0	0.56
36	6 – 25	24.3	50.0	0.68
140	> 95	84.0	71.4	0.68
222	< 5	17.7	36.7	0.97
223	< 5	14.8	38.1	0.77
224	< 5	27.2	68.2	0.79

* Only plot with *Hemarthria altissima* cover > 5%

Table 2. Mean plant species diversity (± standard error) within baseline vegetation plots in Pools A and C. Species diversity was based on relative cover of plant species in each plot.

Community Type			
Historic	Existing	N	Species Diversity
Pool A			
Wet Prairie	Herbaceous (Pasture)	6	0.89 ± 0.12
Broadleaf Marsh	Wet Prairie (Transitional)	3	1.09 ± 0.04
Broadleaf Marsh	Herbaceous (Pasture)	6	0.80 ± 0.05
Broadleaf Marsh	Mesophytic Shrub	3	1.00 ± 0.16
Cephalanthus Shrub	Herbaceous (Pasture)	3	1.34 ± 0.05
Cephalanthus Shrub	Mesophytic Shrub	3	1.06 ± 0.07
Pool C			
Wet Prairie	Herbaceous (Pasture)	21	0.77 ± 0.03
Broadleaf Marsh	Wet Prairie (Transitional)	3	0.85 ± 0.04
Broadleaf Marsh	Herbaceous (Pasture)	9	0.67 ± 0.03
Broadleaf Marsh	Mesophytic Shrub	12	1.13 ± 0.06
Cephalanthus Shrub	Herbaceous (Pasture)	6	1.12 ± 0.08
Cephalanthus Shrub	Mesophytic Shrub	6	0.98 ± 0.08
Salix Shrub	Mesophytic Shrub	3	0.84 ± 0.08

Table 3. Reference conditions for species diversity and relative proportion and biomass of wetland taxa along transects in wet prairie in Pools A and B. The relative proportion (%) of obligate and facultative wetland taxa is based on the mean of all sample quadrats (N) along each transect. Relative (%) biomass is based on mean standing crop within ten samples along each transect. Mean species diversity is based on the average of each standing crop sample and the relative biomass of plant species in these samples.

Transect	Year	N	Mean (± SE) Proportion of Obligate and Facultative Wetland Species	Mean (± SE) Relative Biomass of Obligate and Facultative Wetland Species	Mean (± SE) Plant Species Diversity
DS	1988	51	89.3 ± 1.5	-	-
DS	1990	51	83.3 ± 1.9	94.2 ± 0.02	0.86 (± 0.04)
PI	1988	26	93.5 ± 1.5	-	-
PI	1990	26	93.4 ± 1.6	99.5 ± 0.00	0.70 (± 0.05)
RH	1992	77	99.1 ± 0.6	99.8 ± 0.00	0.41 (± 0.04)
RH	1993	77	95.2 ± 1.0	-	-
RH	1994	77	94.7 ± 0.9	-	-
RH	1997	77	95.6 ± 0.9	-	-

Table 4. Indicator species expected within wet prairie communities on the restored floodplain.

Forbs	Frequency of Occurrence in Wetlands (Reed 1988)
Alternanthera philoxeroides	Obligate
Aster elliotti	Obligate
Bacopa caroliniana	Obligate
Bacopa monnieri	Obligate
Bidens mitis	Obligate
Centella asiatica	Facultative Wetland
Commelina diffusa	Facultative Wetland
Diodea virginiana	Facultative Wetland
Galium tinctorium	Facultative Wetland
Hydrocotyle umbellata	Obligate
Hypericum mutilum	Facultative Wetland
Ludwigia repens	Obligate
Pluchea rosea	Facultative Wetland
Polygonum hirsutum	Obligate
Polygonum punctatum	Facultative Wetland
Proserpinaca palustris	Obligate
Ptilimnium capillaceum	Obligate
Rhexia mariana	Facultative Wetland
Grasses	
Axonopus furcatus	Obligate
Echinochloa walteri	Obligate
Leersia hexandra	Obligate
Luziola fluitans	Obligate
Panicum hemitomon	Obligate
Panicum repens	Facultative Wetland
Panicum rigidulum	Facultative Wetland
Paspalum dissectum	Obligate
Paspalum distichum	Obligate
Paspalum laeve	Facultative Wetland
Spartina bakeri	Facultative Wetland

Table 4 - continued

Sedges and Rushes

Carex longii	Obligate
Cyperus articulatus	Obligate
Cyperus compressus	Facultative Wetland
Cyperus haspan	Obligate
Cyperus polystachyos	Facultative Wetland
Cyperus surinamensis	Facultative Wetland
Eleocharis interstincta	Obligate
Eleocharis vivipara	Obligate
Fimbristylis autumnalis	Obligate
Fimbristylis caroliniana	Facultative Wetland
Fimbristylis dichotoma	Obligate
Fuirena pumila	Obligate
Juncus effusus	Facultative Wetland
Juncus marginatus	Facultative Wetland
Kyllinga brevifolia	Facultative Wetland
Rhynchospora colorata	Facultative Wetland
Rhynchospora inundata	Obligate
Rhynchospora microcarpa	Facultative Wetland
Rhynchospora microcephala	Obligate
Rhynchospora nitens	Obligate
Scleria reticularis	Obligate

Table 5. Modified Daubenmire scale used for differentiating cover classes of plant species within plots.

Cover Class	% Cover
1	1 – 5
2	6 – 25
3	26 – 50
4	51 – 75
5	76 – 95
6	> 95

References

Milleson, J.F., R.L. Goodrick and J.A. Van Arman. 1980. Plant communities of the Kissimmee River valley. South Florida Water Management District Technical Publication 80-7. South Florida Water Management District, West Palm Beach, FL.

Pierce, G.J., A.B. Amerson and L.R. Becker, Jr. 1982. Pre-1960 floodplain vegetation of the lower Kissimmee River valley, Florida. Biological Services Report 82-3, Environmental Consultants, Inc. Dallas, TX.

Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: 1988 Florida. U.S. Fish and Wildlife Service, NERC-88/18.09.

Toth, L.A. 1991. Environmental responses to the Kissimmee River demonstration project. South Florida Water Florida Water Management District, West Palm Beach, FL. 96 p.

Toth, L.A., D.A. Arrington, M.A. Brady and D.A. Muszick. 1995. Conceptual evaluation of factors potentially affecting restoration of habitat structure within the channelized Kissimmee River ecosystem. Restoration Ecology 3: 160-180.

Toth, L.A., S.L. Melvin, D.A. Arrington and J. Chamberlain. 1998. Hydrologic manipulations of the channelized Kissimmee River: implications for restoration. BioScience 48: 757-764.

Wetzel, P.R., A.G. van der Valk and L.A. Toth. 2001. Restoration of wetland vegetation on the Kissimmee River floodplain: potential role of seed banks. Wetlands 21: 189-198.